



ULTRA-LOW VOLTAGE PROCESSOR SUPERVISORY CIRCUITS

FEATURES

- Minimum Supply Voltage of 0.75 V
- Supply Voltage Supervision Range:
 - 1.2 V, 1.5 V, 1.8 V (TPS312x)
 - 3 V (TPS3125 Devices Only)
 - Other Versions on Request
- Power-On Reset Generator With Fixed Delay Time of 180 ms
- Manual Reset Input (TPS3123/5/6/8)
- Watchdog Timer Retriggeres the $\overline{\text{RESET}}$ Output at $V_{DD} \geq V_{IT}$
- Supply Current of 14 μA (Typ)
- Small SOT23-5 Package
- Temperature Range of -40°C to 85°C
- Reset Output Available in Push-Pull (Active Low and High) and Open-Drain (Active-Low)

APPLICATIONS

- Applications Using Low Voltage DSPs, Microcontrollers, or Microprocessors
- Portable/Battery-Powered Equipment
- Wireless Communication Systems
- Programmable Controls
- Industrial Equipment
- Notebook/Desktop Computers
- Intelligent Instruments

DBV PACKAGE
(TOP VIEW)

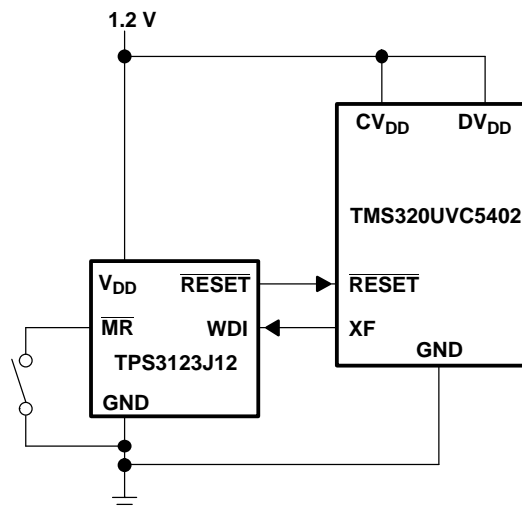
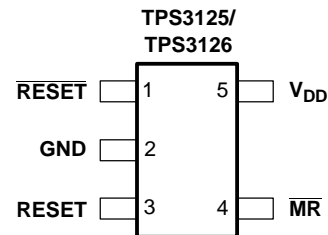
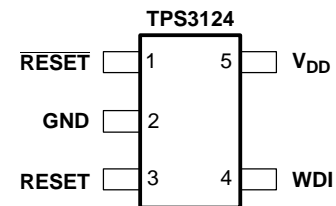
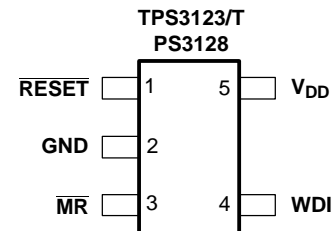


Figure 1. Typical Low-Voltage DSP Application



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

DESCRIPTION

The TPS312x family of ultralow voltage processor supervisory circuits provides circuit initialization and timing supervision, primarily for DSP and processor-based systems.

During power-on, $\overline{\text{RESET}}$ is asserted when the supply voltage (V_{DD}) becomes higher than 0.75 V. Thereafter, the supply voltage supervisor monitors V_{DD} and keeps $\overline{\text{RESET}}$ output active as long as V_{DD} remains below the threshold voltage (V_{IT}). An internal timer delays the return of the output to the inactive state (high) to ensure proper system reset. The delay time, $t_{\text{d}} = 180$ ms, starts after V_{DD} has risen above the threshold voltage (V_{IT}).

When the supply voltage drops below the threshold voltage (V_{IT}), the output becomes active (low) again. No external components are required. All the devices of this family have a fixed-sense threshold voltage (V_{IT}) set by a high precision internal voltage divider.

The TPS3123/5/6/8 devices incorporate a manual reset input, $\overline{\text{MR}}$. A low level at $\overline{\text{MR}}$ causes $\overline{\text{RESET}}$ to become active. The TPS3124 devices do not have the input $\overline{\text{MR}}$, but include a high-level output RESET same as the TPS3125 and TPS3126 devices. In addition, the TPS3123/4/8 have a watchdog timer that needs to be triggered periodically by a positive or negative transition at WDI. When the supervising system fails to retrigger the watchdog circuit within the time-out interval $t_{\text{tout}} = 0.8$ s, $\overline{\text{RESET}}$ output becomes active for the time period (t_{d}). This event also reinitializes the watchdog timer.

The circuits are available in a 5-pin SOT23-5 package. The TPS312x devices are characterized for operation over a temperature range of -40°C to 85°C .

PACKAGE INFORMATION STANDARD VERSIONS⁽¹⁾

| T_{A} | DEVICE NAME | | THRESHOLD VOLTAGE | MARKING |
|---|-------------------------------|-------------------------------|-------------------|---------|
| -40°C to 85°C | TPS3123J12DBVR ⁽²⁾ | TPS3123J12DBVT ⁽³⁾ | 1.08 V | PBNI |
| | TPS3123G15DBVR ⁽²⁾ | TPS3123G15DBVT ⁽³⁾ | 1.40 V | PBOI |
| | TPS3123J18DBVR ⁽²⁾ | TPS3123J18DBVT ⁽³⁾ | 1.62 V | PBPI |
| | TPS3124J12DBVR ⁽²⁾ | TPS3124J12DBVT ⁽³⁾ | 1.08 V | PBQI |
| | TPS3124G15DBVR ⁽²⁾ | TPS3124G15DBVT ⁽³⁾ | 1.40 V | PBRI |
| | TPS3124J18DBVR ⁽²⁾ | TPS3124J18DBVT ⁽³⁾ | 1.62 V | PBSI |
| | TPS3125J12DBVR ⁽²⁾ | TPS3125J12DBVT ⁽³⁾ | 1.08 V | PBTI |
| | TPS3125G15DBVR ⁽²⁾ | TPS3125G15DBVT ⁽³⁾ | 1.40 V | PBUI |
| | TPS3125J18DBVR ⁽²⁾ | TPS3125J18DBVT ⁽³⁾ | 1.62 V | PBVI |
| | TPS3125L30DBVR ⁽²⁾ | TPS3125L30DBVT ⁽³⁾ | 2.64 V | PBXI |
| | TPS3126E12DBVR ⁽²⁾ | TPS3126E12DBVT ⁽³⁾ | 1.14 V | PFOI |
| | TPS3126E15DBVR ⁽²⁾ | TPS3126E15DBVT ⁽³⁾ | 1.43 V | PFPI |
| | TPS3126E18DBVR ⁽²⁾ | TPS3126E18DBVT ⁽³⁾ | 1.71 V | PFQI |
| | TPS3128E12DBVR ⁽²⁾ | TPS3128E12DBVT ⁽³⁾ | 1.14 V | PFRI |
| TPS3128E15DBVR ⁽²⁾ | TPS3128E15DBVT ⁽³⁾ | 1.43 V | PFSI | |
| TPS3128E18DBVR ⁽²⁾ | TPS3128E18DBVT ⁽³⁾ | 1.71 V | PFTI | |

(1) Other versions available. Contact Texas Instruments for details, minimum order quantities apply.

(2) The DBVR passive indicates tape and reel of 3000 parts.

(3) The DBVT passive indicates tape and reel of 250 parts.

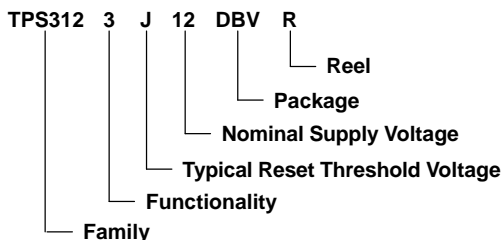


Table 1. Ordering Information Application Specific Versions ⁽¹⁾

| DEVICE NAME | NOMINAL SUPPLY VOLTAGE, V_{NOM} | DEVICE NAME | TYPICAL RESET THRESHOLD VOLTAGE- V_{IT} |
|---------------|--------------------------------------|---------------|--|
| TPS312xx12DBV | 1.2 V | TPS312xAxxDBV | V_{NOM} -1% |
| TPS312xx15DBV | 1.5 V | TPS312xBxxDBV | V_{NOM} -2% |
| TPS312xx18DBV | 1.8 V | TPS312xCxxDBV | V_{NOM} -3% |
| TPS312xx30DBV | 3.0 V | TPS312xDxxDBV | V_{NOM} -4% |
| | | TPS312xExxDBV | V_{NOM} -5% |
| | | TPS312xFxxDBV | V_{NOM} -6% |
| | | TPS312xGxxDBV | V_{NOM} -7% |
| | | TPS312xHxxDBV | V_{NOM} -8% |
| | | TPS312xIxxDBV | V_{NOM} -9% |
| | | TPS312xJxxDBV | V_{NOM} -10% |
| | | TPS312xKxxDBV | V_{NOM} -11% |
| | | TPS312xLxxDBV | V_{NOM} -12% |
| | | TPS312xMxxDBV | V_{NOM} -13% |
| | | TPS312xNxxDBV | V_{NOM} -14% |
| | | TPS312xOxxDBV | V_{NOM} -15% |

(1) For the application specific versions contact Texas Instruments for availability, lead time, and minimum order quantities.

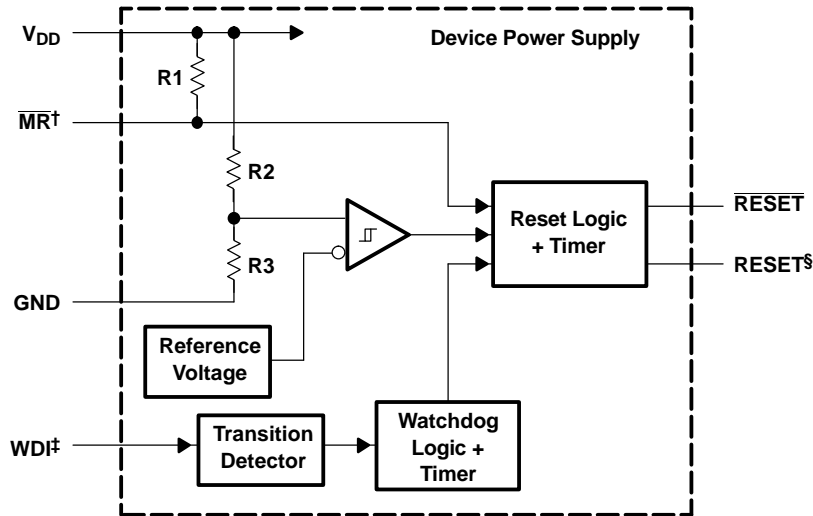
Table 2. Function Tables

| TPS3123/8 | | | TPS3124 | | | TPS3125/6 | | | |
|-----------|----------------|-------|----------------|-------|-------|-----------|----------------|-------|-------|
| MR | VDD > V_{IT} | RESET | VDD > V_{IT} | RESET | RESET | MR | VDD > V_{IT} | RESET | RESET |
| L | 0 | L | 0 | L | H | L | 0 | L | H |
| L | 1 | L | 1 | H | L | L | 1 | L | H |
| H | 0 | L | | | | H | 0 | L | H |
| H | 1 | H | | | | H | 1 | H | L |

Reset Topology

| DEVICES | OPEN DRAIN | PUSH-PULL |
|---------|------------|-----------|
| TPS3123 | | X |
| TPS3124 | | X |
| TPS3125 | | X |
| TPS3126 | X | |
| TPS3128 | X | |

FUNCTIONAL BLOCK DIAGRAM

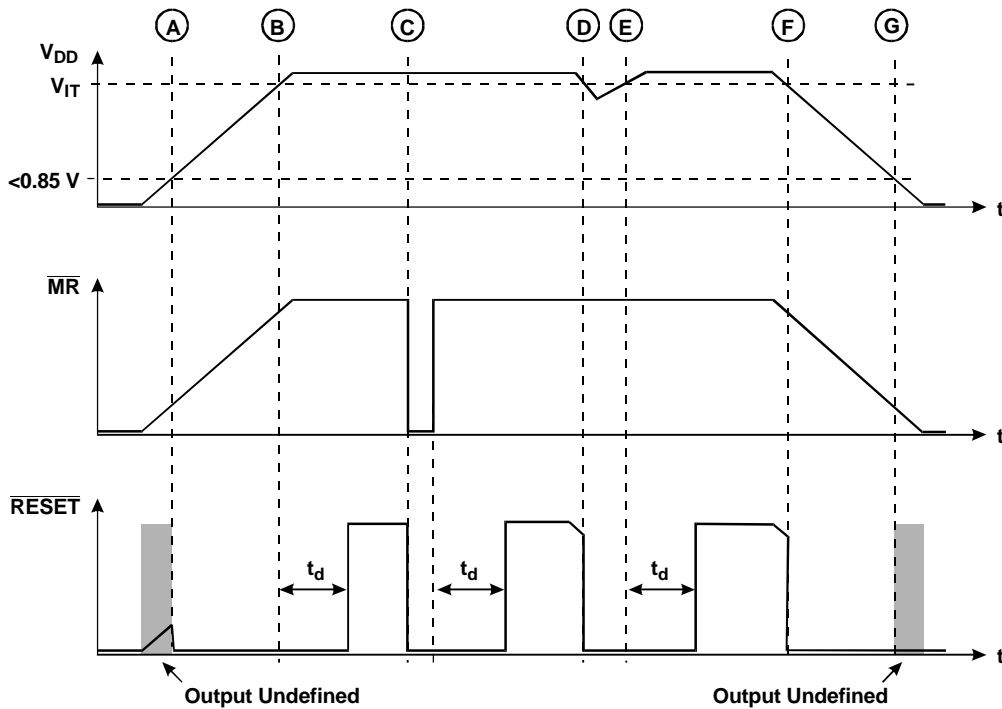


† TPS3123/5/6/8

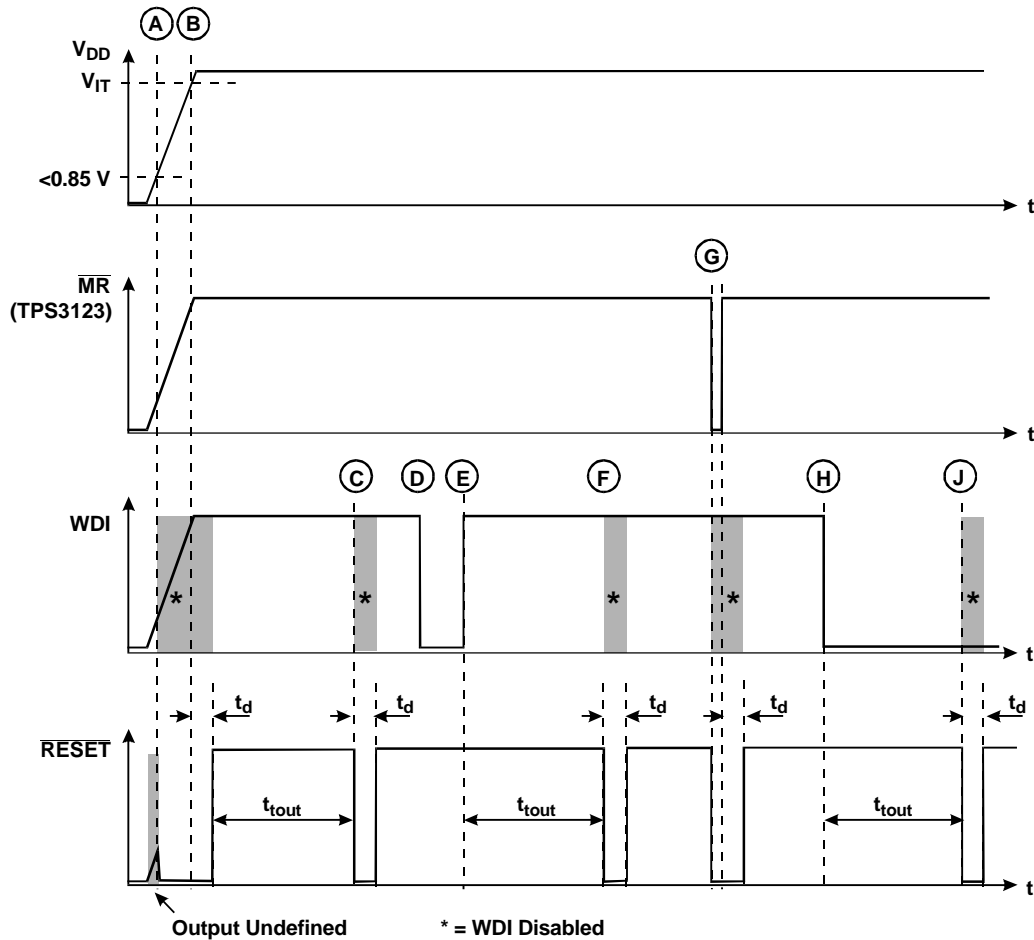
‡ TPS3123/4/8

§ TPS3124/5/6

TIMING DIAGRAM TPS3123/5/6/8



TIMING DIAGRAM TPS3123/4//8



ABSOLUTE MAXIMUM RATINGS

over operating free-air temperature range (unless otherwise noted)⁽¹⁾

| | UNIT |
|--|-----------------------------------|
| Manual reset, \overline{MR} | -0.3 V to $V_{DD} + 0.6\text{ V}$ |
| Supply voltage, V_{DD} | 3.6 V |
| Watchdog input, WDI | -0.3 V to $V_{DD} + 6\text{ V}$ |
| Maximum low output current, I_{OL} | 5 mA |
| Maximum high output current, I_{OH} | -5 mA |
| Input clamp current, I_{IK} ($V_I < 0$ or $V_I > V_{DD}$) | $\pm 10\text{ mA}$ |
| Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{DD}$) | $\pm 10\text{ mA}$ |
| Continuous total power dissipation | See Dissipation Rating Table |
| Operating free-air temperature range, T_A | -40°C to 85°C |
| Storage temperature range, T_{stg} | -65°C to 150°C |
| Soldering temperature | 260°C |

(1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

DISSIPATION RATING TABLE

| PACKAGE | T _A ≤ 25°C POWER RATING | DERATING FACTOR ABOVE T _A = 25°C | T _A = 70°C POWER RATING | T _A = 85°C POWER RATING |
|---------|---------------------------------------|--|---------------------------------------|---------------------------------------|
| DBV | 437 mW | 3.5 mW/°C | 280 mW | 227 mW |

RECOMMENDED OPERATING CONDITIONS

at specified temperature range

| | MIN | MAX | UNIT |
|--|--------------------------------|----------------------|------|
| Supply voltage, V _{DD} | T _A = 0°C to 85°C | | V |
| | 0.75 | 3.3 | |
| Manual reset voltage, V _{DD} | T _A = -40°C to 85°C | | V |
| | 0.85 | 3.3 | |
| Watchdog input voltage, V _{WD1} | 0 | V _{DD} +0.3 | V |
| High-level input voltage, V _{IH} | 0.7×V _{DD} | | V |
| Low-level input voltage, V _{IL} | 0.3×V _{DD} | | V |
| Input transition rise and fall rate at WDI, Δ t/ΔV | 1 | | μs/V |
| Operating free-air temperature range, T _A | 40 | 85 | °C |

ELECTRICAL CHARACTERISTICS

over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|--------------------------------|--|------|-----------------------|------|
| $\overline{\text{MR}}$ pullup resistor (internal) | | | 27 | | | kΩ |
| I _{IH} | High-level input current | WDI | V _{DD} = 3.3 V | | | μA |
| | | MR | MR = 0.7 × V _{DD} , V _{DD} = 3.3 V | | | |
| I _{IL} | Low-level input current | WDI | V _{DD} = 3.3 V | | | μA |
| | | MR | MR = 0 V, V _{DD} = 3.3 V | | | |
| I _{OH} | High-level output current (leakage into RESET pin) | TPS3126-xx, TPS3128-xx | V _{DD} = V _{OH} = 3.3 V | | | nA |
| V _{OH} | High-level output voltage (TPS3123/4/5 only) | RESET | V _{DD} = 1.5 V, I _{OH} = -1 mA | | 0.8×V _{DD} | V |
| | | | V _{DD} = 3.3 V, I _{OH} = -4.5 mA | | | |
| | | RESET | V _{DD} = 0.75 V, I _{OH} = -8 μA | | | |
| | | | V _{DD} = 1.5 V, I _{OH} = -1 mA | | | |
| V _{OL} | Low-level output voltage | RESET | V _{DD} = 0.75 V, I _{OL} = 15 μA | | 0.2 × V _{DD} | V |
| | | | V _{DD} = 1.5 V, I _{OL} = 1.4 mA | | | |
| | | RESET | V _{DD} = 1.5 V, I _{OL} = 1.4 mA | | | |
| | | | V _{DD} = 3.3 V, I _{OL} = 3 mA | | | |
| V _{IT-} | Negative-going input threshold voltage ⁽¹⁾ | TPS312xJ12 | T _A = -40°C to 85°C | | | V |
| | | TPS312xG15 | 1.04 | 1.08 | 1.12 | |
| | | TPS312xJ18 | 1.35 | 1.40 | 1.45 | |
| | | TPS312xL30 | 1.56 | 1.62 | 1.68 | |
| | | TPS312xE12 | 2.57 | 2.64 | 2.71 | |
| | | TPS312xE15 | 1.10 | 1.14 | 1.18 | |
| | | TPS312xE18 | 1.38 | 1.43 | 1.48 | |
| V _{hys} | Hysteresis at V _{DD} input | 1 V < V _{IT-} < 1.4 V | | 15 | | mV |
| | | 1.4 V < V _{IT-} < 2 V | | 20 | | |
| | | 2 V < V _{IT-} < 3 V | | 30 | | |

(1) To ensure best stability of the threshold voltage, a bypass capacitor (ceramic, 0.1 μF) should be placed near the supply terminal.

ELECTRICAL CHARACTERISTICS (continued)

over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|-----------|--|--|---|--------------------------|-----|-----|---------------|
| I_{DD} | Supply current | TPS3123-xx TPS3124-xx TPS3128-xx | WDI = V_{DD} , \overline{MR} unconnected | $V_{DD} = 0.75\text{ V}$ | 14 | | μA |
| | | | | $V_{DD} = 3.3\text{ V}$ | 22 | 30 | |
| | | TPS3125-xx TPS3126-xx (2) | \overline{MR} unconnected | $V_{DD} = 0.75\text{ V}$ | 14 | | |
| | | | | $V_{DD} = 3.3\text{ V}$ | 18 | 25 | |
| C_i | Input capacitance at \overline{MR} , WDI | $V_i = 0\text{ V to } 3.3\text{ V}$ | | 5 | | | pF |

(2) The supply current during delay time t_d is typical 5 μA higher.

TIMING REQUIREMENTS

at $R_L = 1\text{ M}\Omega$, $C_L = 50\text{ pF}$, $T_A = 25^\circ\text{C}$

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|-----------|-------------|--------------------|--|-----|-----|-----|---------------|
| t_w | Pulse width | At V_{DD} | $V_{IH} = V_{IT-} + 0.2\text{ V}$, $V_{IL} = V_{IT-} - 0.2\text{ V}$ | 6 | | | μs |
| | | At \overline{MR} | $V_{DD} \geq V_{IT-} + 0.2\text{ V}$, $V_{IL} = 0.3 \times V_{DD}$, $V_{IH} = 0.7 \times V_{DD}$ | 1 | | | |
| | | At WDI | | 0.1 | | | |

SWITCHING CHARACTERISTICS

at $R_L = 1\text{ M}\Omega$, $C_L = 50\text{ pF}$, $T_A = 25^\circ\text{C}$

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|-------------------|--|--|--|-----|-----|-----|---------------|
| t_{tout} | Watchdog time out | $V_{DD} \geq V_{IT-} + 0.2\text{ V}$, See timing diagram | | 0.8 | 1.4 | 2.1 | s |
| t_d | Delay time | $V_{DD} > V_{IT-} + 0.2\text{ V}$, See timing diagram | | 100 | 180 | 260 | ms |
| t_{PHL} | Propagation delay time, high-to-low-level output | \overline{MR} to RESET delay (TPS3123/5/6/8) | $V_{DD} \geq V_{IT-} + 0.2\text{ V}$, $V_{IL} = 0.2 \times V_{DD}$, $V_{IH} = 0.8 \times V_{DD}$ | | | 0.1 | μs |
| t_{PLH} | Propagation delay time, low-to-high-level output | \overline{MR} to RESET delay (TPS3125/6) | | | | 0.1 | |
| t_{PHL} | Propagation delay time, high-to-low-level output | V_{DD} to RESET delay | $V_{IL} = V_{IT-} - 0.2\text{ V}$, $V_{IH} = V_{IT-} + 0.2\text{ V}$ | | | 10 | μs |
| t_{PLH} | Propagation delay time, low-to-high-level output | V_{DD} to RESET delay (TPS3124/5/6) | | | | 10 | |

TYPICAL CHARACTERISTICS

SUPPLY CURRENT
 vs
 SUPPLY VOLTAGE

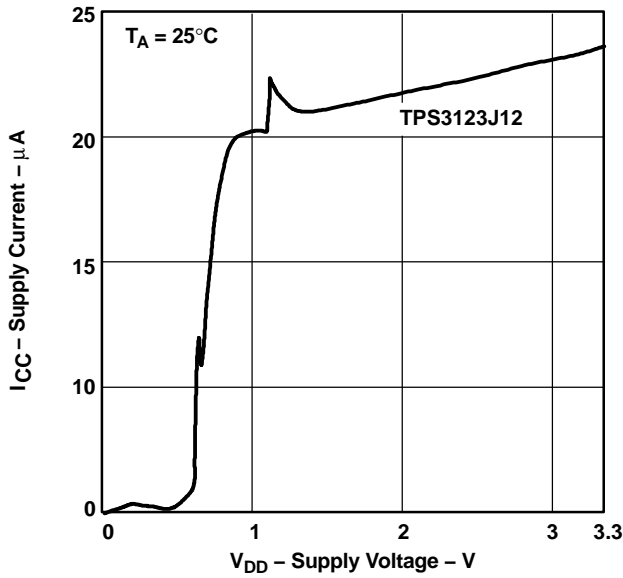


Figure 2.

LOW-LEVEL OUTPUT VOLTAGE
 vs
 LOW-LEVEL OUTPUT CURRENT

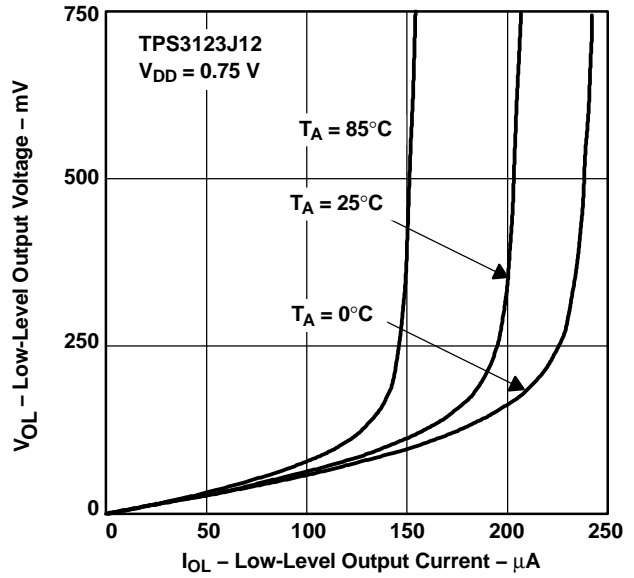


Figure 3.

LOW-LEVEL OUTPUT VOLTAGE
 vs
 LOW-LEVEL OUTPUT CURRENT

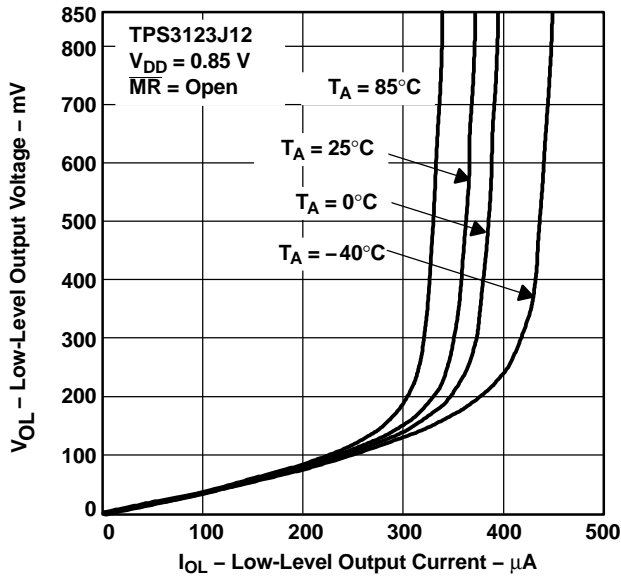


Figure 4.

LOW-LEVEL OUTPUT VOLTAGE
 vs
 LOW-LEVEL OUTPUT CURRENT

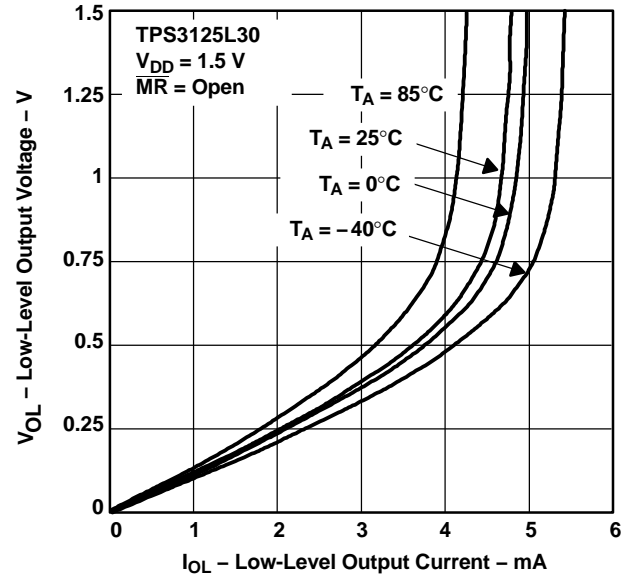


Figure 5.

TYPICAL CHARACTERISTICS (continued)

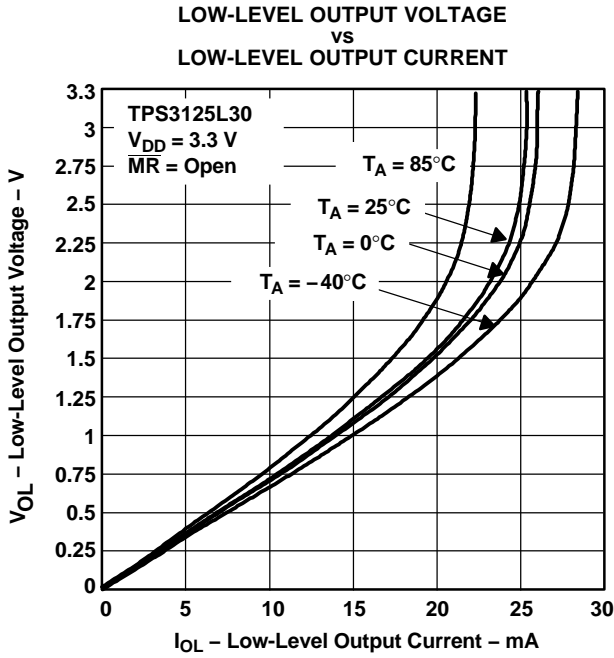


Figure 6.

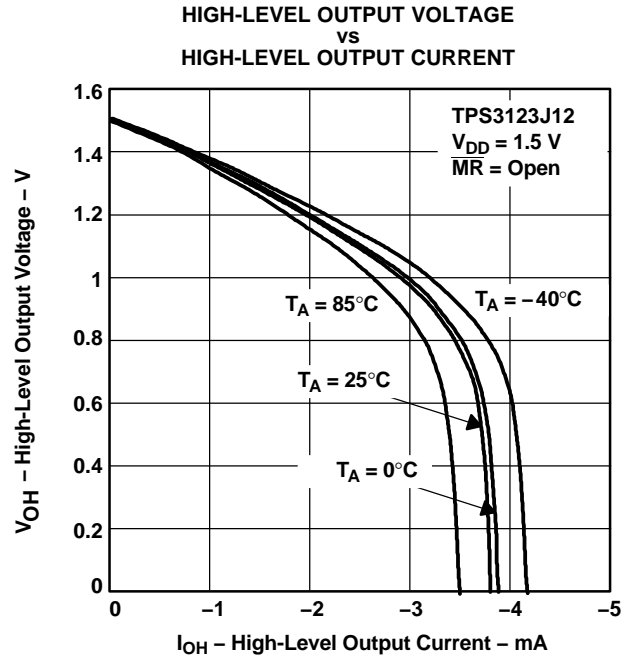


Figure 7.

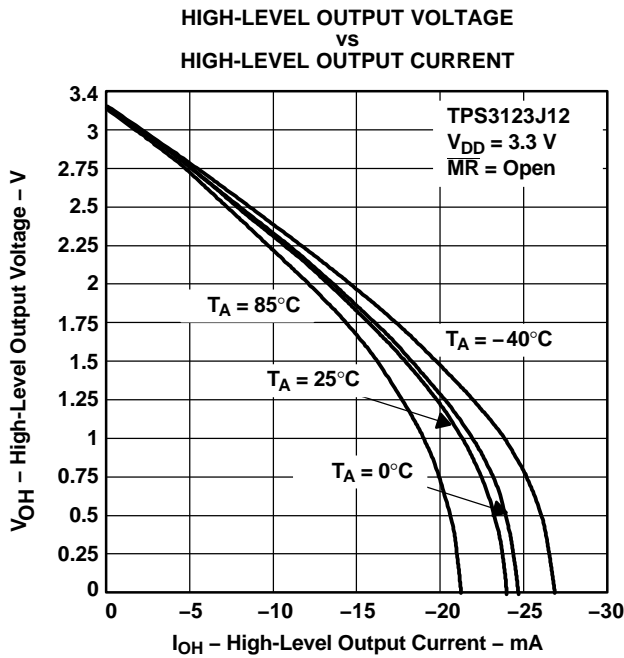


Figure 8.

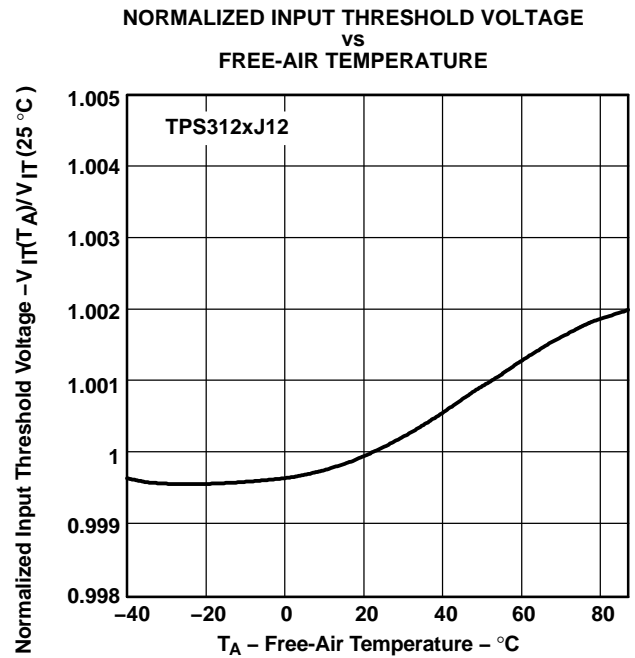


Figure 9.

TYPICAL CHARACTERISTICS (continued)

NORMALIZED INPUT THRESHOLD VOLTAGE
 vs
 FREE-AIR TEMPERATURE

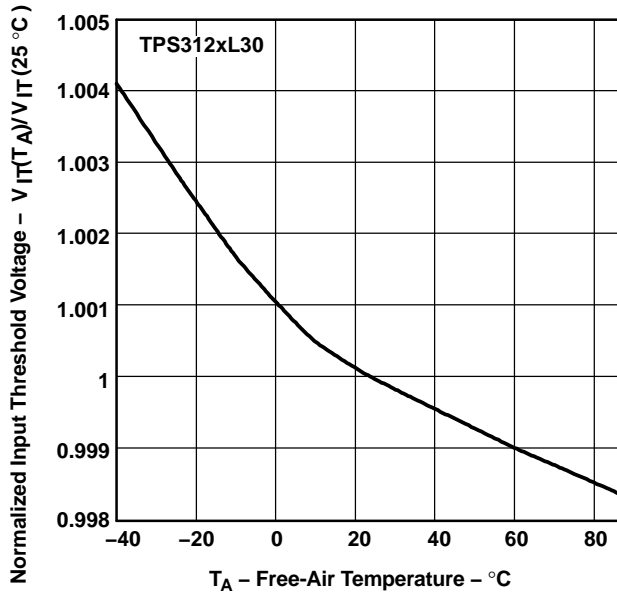


Figure 10.

MINIMUM PULSE DURATION
 vs
 THRESHOLD OVERDRIVE

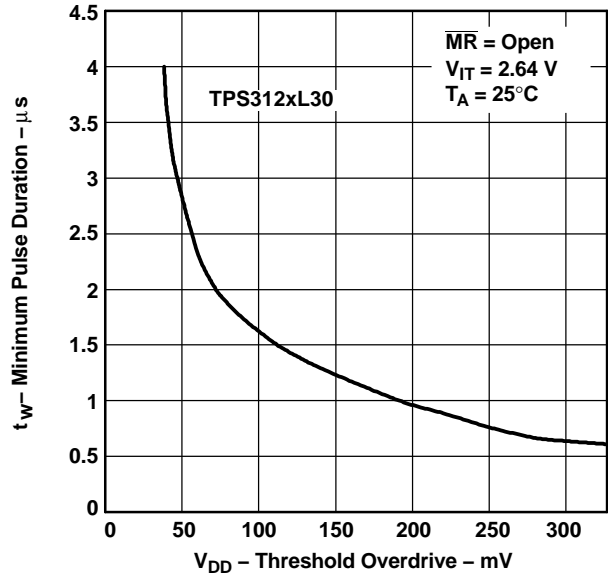


Figure 11.

MINIMUM PULSE DURATION
 vs
 THRESHOLD OVERDRIVE

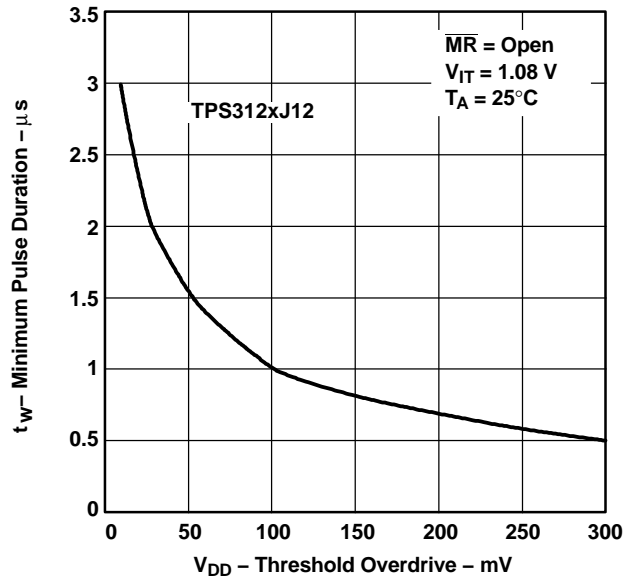
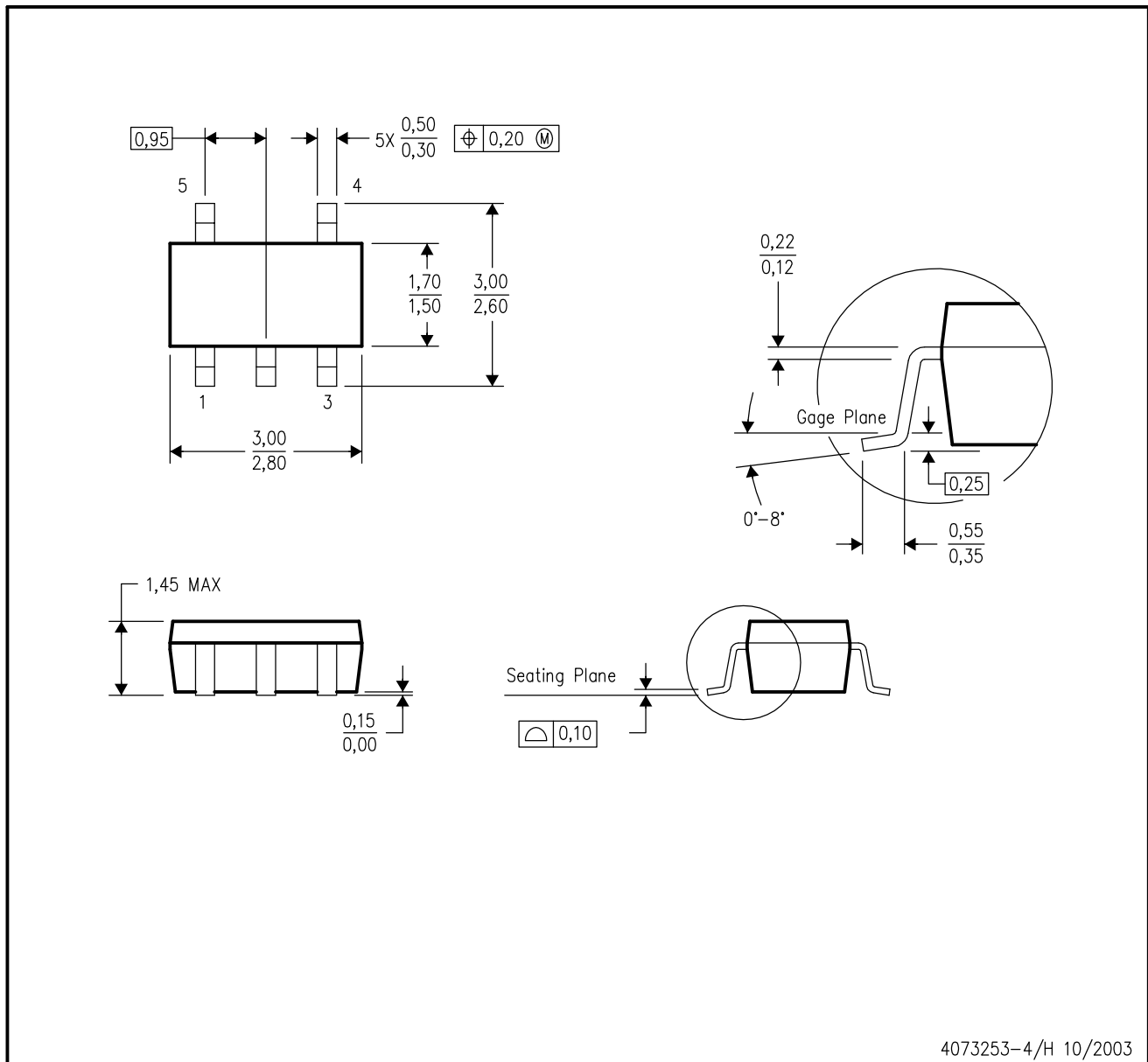


Figure 12.

DBV (R-PDSO-G5)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion.
 - D. Falls within JEDEC MO-178 Variation AA.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

| Products | | Applications | |
|------------------|--|---------------------|--|
| Amplifiers | amplifier.ti.com | Audio | www.ti.com/audio |
| Data Converters | dataconverter.ti.com | Automotive | www.ti.com/automotive |
| DSP | dsp.ti.com | Broadband | www.ti.com/broadband |
| Interface | interface.ti.com | Digital Control | www.ti.com/digitalcontrol |
| Logic | logic.ti.com | Military | www.ti.com/military |
| Power Mgmt | power.ti.com | Optical Networking | www.ti.com/opticalnetwork |
| Microcontrollers | microcontroller.ti.com | Security | www.ti.com/security |
| | | Telephony | www.ti.com/telephony |
| | | Video & Imaging | www.ti.com/video |
| | | Wireless | www.ti.com/wireless |

Mailing Address: Texas Instruments
Post Office Box 655303 Dallas, Texas 75265